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IMPLENTATION OF VOICE CONTROLLED ROBOT USING ANDROID APPLICATION

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Abstract: This paper proposes a system where the human voice is a main source to control devices. With the help of an android smartphone application, human voice commands are recognised and these commands are then processed to achieve the corresponding control of any real world device. This system is a prototype of a voice controlled wheelchair-where voice commands can be effectively used to control the movement of a wheelchair. By the simple use of an efficient control system utilising the Arduino microcontroller board, the HC-05 Bluetooth module and an easy user interface based android smartphone voice application, the control of the robot is achieved. Results show that it is indeed possible to efficiently manipulate and automate real world activities with only voice (human voice) as a control mechanism.

Keywords: Voice command, Bluetooth, Android Interface, Arduino

I. INTRODUCTION

A survey aimed to collect information from patients concerning the usefulness of new electric wheelchairs concluded that 9 to 10% of patients who use power wheel chairs and who received appropriate training "find it extremely difficult or impossible to use the wheelchair for activities of daily living." Independent mobility increases vocational and educational opportunities, reduces dependence on caregivers and family members and promotes feelings of self-reliance.

It is an important aspect of self-esteem that plays a pivotal role in aging in place. While the needs of many individuals with disabilities can be satisfied with traditional manual or power wheelchairs, a segment of the disabled community finds it difficult or impossible to use wheelchairs independently. This population includes individuals with low vision, visual field reduction, spasticity, tremors or cognitive deficits. The idea of using voice activated technology for controlling the motion of the wheelchair would greatly simply the everyday task for the many people with disabilities who do not have the dexterity necessary to control a joystick on an electric wheelchair. Some of the pointed reasons are difficulties in controlling the wheelchair with a joystick, uncomfortable and inappropriate interface for the disability (because users with severe motor impairments are unable to operate the joystick smoothly).

For elderly patients, arthritis is one of the major reasons for wheelchair use. The repeated usage of joysticks and continuous wrist movements can be very painful for an arthritic patient, and may result in reinforced difficulties. For the referred groups of users, a voice based interface is highly encouraging because it represents a natural and simple way of controlling the device. For other types of disabilities different types of interfacing devices can be used.

The advent of smartphone applications has tremendously influenced the way in which appliances can be automated. By building a simple user interface smartphone application, the wheelchair can be controlled. The smartphone app recognises human voice, deciphers the commands being said and converts them to text. The text is then sent to the main system that controls the device with the help of Bluetooth technology. Bluetooth is used here as it is a reliable means of communication and can be used for a range of about 100m which suffices the system specifications in this case of voice controlled robot. With the help of the Arduino Uno ATMega 328P microcontroller board, the corresponding control mechanism of the robot is carried out.

This paper presents a review of the implemented prototype of a voice controlled wheelchair mechanism by the means of a four wheeled robot utilising the android application known as 'BT voice control for Arduino'.

II. METHODOLOGY

The current power wheelchair control interfaces are still not enough to provide truly independent mobility for substantial number of people with disabilities. A physically challenged person with locomotive

disabilities needs a wheelchair to move around and he does so manually by pushing the wheelchair with his hands.

Thus a solution that can be derived from this is to introduce a voice control interface that would enable the users to interact with the controller with just the help of voice commands. The voice control interface helps in attaining a hands-free control that can be implemented on any kind of wheel chair and can also be used by those who are unable to monitor using the joysticks. This kind of system can be implemented in several other systems too. Since the motorized wheelchair can move at a fair speed it is important that it be able to avoid obstacles automatically in real time.

The Voice controlled robot, a prototype to demonstrate the voice control mechanism that can be implemented for a wheelchair, is controlled with the help of voice activated - Arduino Uno microcontroller board. This system utilizes an Arduino Uno, a Bluetooth module- HC05 and a smartphone to control the motors driving the robot. The commands for the robot are sent via Android's speech recognition app created using the MIT Inventor software. These voice commands are sent through the app via Bluetooth as a string of data to the Arduino. The microcontroller then processes these data strings and correspondingly controls the motors of the robot. The command is also displayed on the app as well as the com port connecting the Arduino module in the IDE. The main components of the control system of the given robot are given as follows.

A. Arduino Uno ATMega328P

The Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

The Arduino Uno has in built ADC components and can process both analog and digital signals.

The Atmega328 has 32 KB of flash memory for storing code (of which 0.5 KB is used for the bootloader). It has also 2 KB of SRAM and 1 KB of EEPROM. The Arduino Uno has an operating voltage of 5V; a recommended input of 7V-12V can be applied to it. However, the Arduino Uno does not have a current driving capacity to drive all the DC motors attached to it- thereby requiring an intermediate motor driver circuit.

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms.

The Bluetooth interface to the Arduino is achieved with the help of the Serial in-out pins of the Arduino namely: Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip. The Arduino Uno is programmed using the Arduino IDE software using a set of C/C++ functions.

B. Bluetooth Module HC05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Bluetooth communication is an effective technology as the range of Bluetooth is found to be 100m. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm.

This simple Bluetooth module architecture easily simplifies the system. The easy to interface module can be connected easily to the Arduino Uno board via the Tx and Rx Serial pins available on the board. The module can be connected to an android smartphone by the means of the smartphone application- 'BT voice control for arduino'.

C. Adafruit Motor Shield

Since the DC current of the Arduino Digital I/O pins is found to be about 40mA, the current isn't sufficient to drive all the DC motors directly. By using the Adafruit Motor Shield consisting of 3 L293D ICs which are motor drivers, as many as 4 DC motors, 2 servo motors and 2 stepper motor can be efficiently controlled by the Arduino.

The pins of the motor shield can be directly placed on the Arduino Uno board in the form of a stack. An external power supply of 12 V is provided to the motor shield for powering all the motors connected to the shield.

D. DC Motors

The robot utilised two DC motors that drive the two wheels at the front while the two wheels at the back follow the ones at the front. According to the command voiced out to the app, the Bluetooth module

deciphers it, converts it to text and sends it to the Arduino board. The microcontroller then processes the command and correspondingly, passes a signal to the motor shield for the right motor to move. The electric signal that is sent to the motor is converted to mechanical energy that hence, rotates the shaft of the motor. The wheel attached to the shaft of the motor then rotates, producing a linear forward or backward motion of the robot.

Two 30 rpm gear motors were used in this system that is powered by a total of 12V supplied to the motor shield.

III. BLOCK DIAGRAM

The basic block diagram of the simple voice controlled robot is given below. It consists of the smartphone that recognises the voice commands and are being wirelessly transferred to the Bluetooth module HC05. The module then converts the command to text and the string of characters are sent to the Arduino for further processing. The Arduino microcontroller decodes the string obtained and correspondingly performs further functions. The signals are sent to the motor shield that hence powers and drives the motors connected to it.

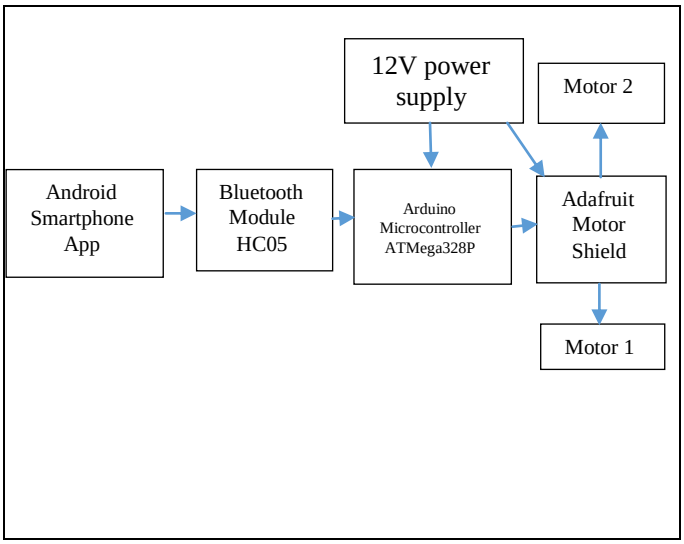

Fig 1.Block Diagram

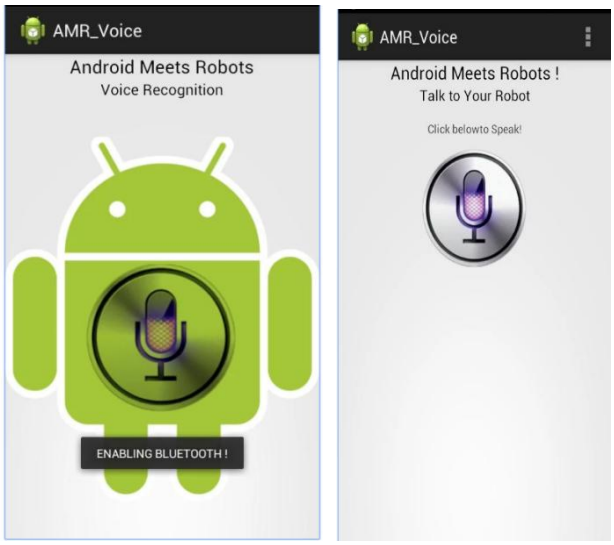

Fig 2.Screenshots of the BT Voice Control App

IV. IMPLEMENTATION

The robot is designed to be controlled by the means of voice commands. It requires a smartphone to implement voice control.

This system uses the android application in the smartphone to recognize verbal instructions instead of using a speech recognition module. It uses google speech to text to recognize and process human voice. This processed text is sent to the microcontroller through Bluetooth. The microcontroller further processes the commands to control the robot accordingly. The procedure to operate the voice controlled bot is as follows:

1. Download and install the app 'BT Voice Control for Arduino' on the smartphone.
2.The app automatically switches on Bluetooth when opened. Ensuring that the robot is switched on, select 'Connect Robot' from the menu options and select the 'HC-05' to establish pairing. (The default password for pairing is either 0000 or 1234)
3. Once successfully paired, click on the microphone symbol to issue the verbal commands.
4. The commands accepted by the robot are 'Forward', 'Backward', 'Left', 'Right' and 'Stop'.

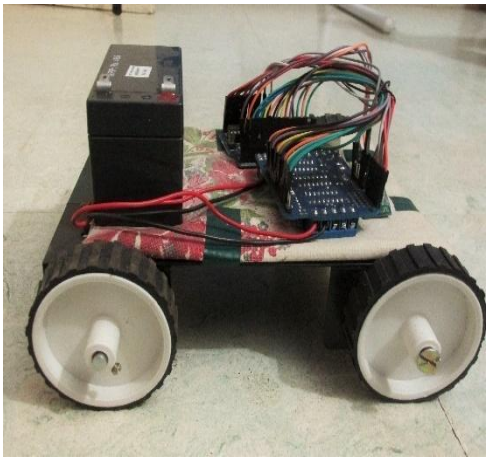

Fig 3. The Robot

V.RESULT AND DISCUSSION

The voice controlled robot was implemented and using the right algorithm, the robot was manoeuvred effectively using voice commands. The robot was able to move forward, backward, right, left and stop when initiated

VI.CONCLUSION

The prototype revealed the simplicity of a voice controlled system such as the wheelchair. It depicts how control mechanism can be obtained without having to use any other control mechanism such as buttons or joystick. By improving the voice reception and inducing further commands, the devices can be automated to the fullest.

VII. FUTURE SCOPE

The automatic voice control robot utilises a simple voice app that recognises voice commands. The app could be further developed using background noise eliminating tools in order to capture only the command and hence making the system more efficient. There is also a vast research undergoing in the stream of sensors used in smartphones that eliminate noise and detect only the required speech signals. Using such advanced signal processing techniques, the wheelchair mechanism can be efficiently developed and implemented.

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